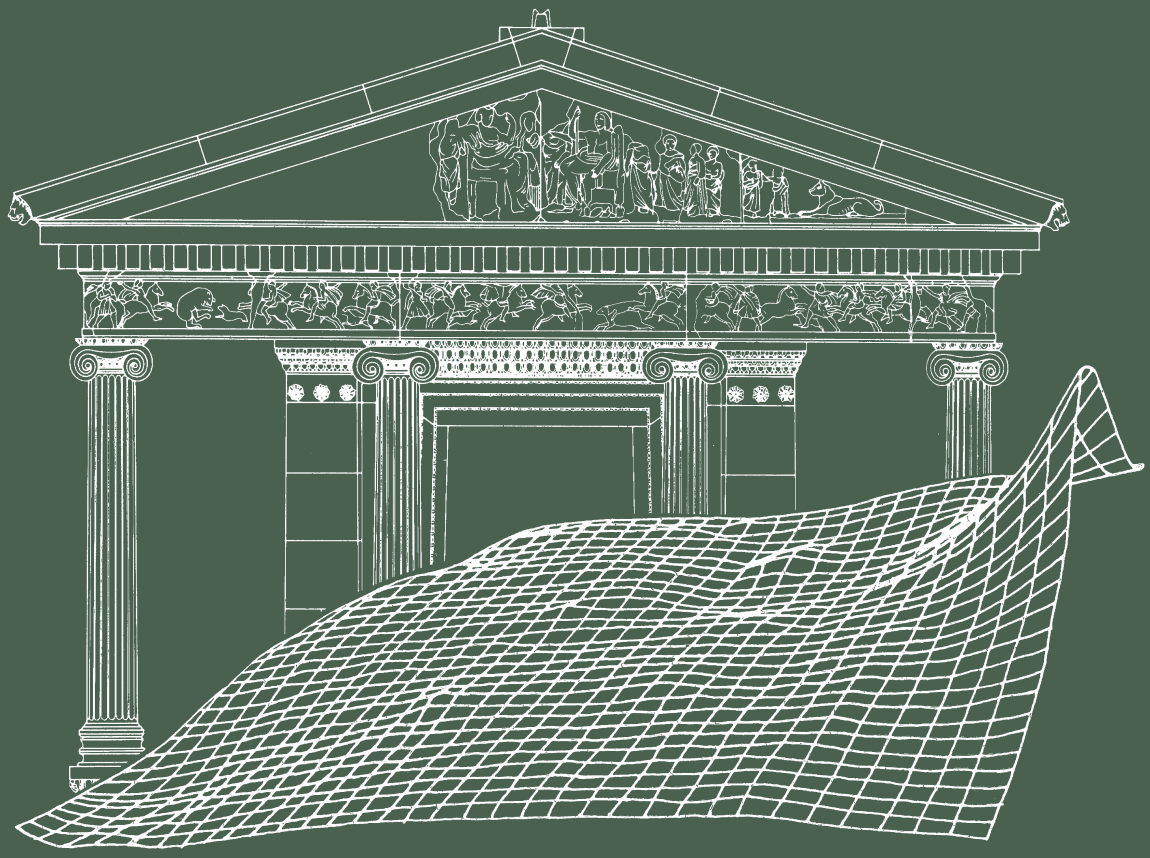

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A POSTPHENOMENOLOGICAL PERSPECTIVE ON DIGITAL AND ALGORITHMIC ARCHAEOLOGY

1. Introduction

This contribution stems from the reflections arising on the sidelines of the ArchAIDE project, which developed an Artificial Intelligence (AI) application for automatic recognition of pottery using Deep Learning algorithms (Anichini *et al.* 2021). ArchAIDE is based on two neural networks: one dedicated to image recognition (also called appearance-based recognition, for pottery decorations) and the other for shape recognition (for pottery types). By taking just one picture of the potsherd to recognise and sending it to the classifier, the ArchAIDE app returns five answers ranked based on the algorithm's confidence. The answers are all linked to the information (drawing, images, text, 3D models, locations, etc.) collected in the reference database, and the user can compare the information with the potsherd found. When I first used it through my mobile device, apart from a feeling of magic, I felt a sensation of disruptiveness. My smartphone was mediating between me and the potsherds. I no longer had the need to take the potsherd in my hand, see and touch its surfaces, or observe or lick the paste for performing hermeneutics; I only had to take a picture through my smartphone. Technology was performing cognition instead of me.

The time has come to reflect on the use of AI in archaeology, trying to understand, among the others, how technological mediation takes place in archaeology through AI and if its effects are disruptive concerning epistemology and hermeneutics. This contribution will follow Postphenomenology and material hermeneutics to describe the relationship between archaeology and AI. Postphenomenology developed a philosophy of scientific practice closest to empirical research (Ihde 1990; Verbeek 2005; Ihde 2009; Rosenberger, Verbeek 2015; de Boer *et al.* 2018). In Postphenomenology, the key concept concerns the technologies' mediation role of humans' relations with the world, in which technologies act as active and no-neutral intermediaries in establishing how the world is disclosed to scientists. Nonetheless, this *active shaping* is one with the scientist who employs the instrument and both of them as a whole are included in the concept of technological mediation (de Boer *et al.* 2018). Furthermore, Postphenomenology ascribes hermeneutical aspects to technologies and defines hermeneutical relations as those through which humans read and interpret the world via technologies (Ihde 2009, 43).

As some scholars (Huggett 2017; Wellner 2020) also point out, digital technologies have a material aspect in the complex apparatus composed of

fibre optic cables, servers, satellites, displays, et cetera. Besides, digital technologies *give voice* to things, deliver new significances to information structures and conduct users to specific meanings, and once they come to AI, they also possess technological intentionality (Verbeek 2008; Wellner 2020).

2. Postphenomenology in brief

Postphenomenology has been theorised by Don Ihde (1990, 2009, 2012) as a modified hybrid phenomenology that takes its origin from Husserl, Heidegger, Merleau-Ponty philosophies. Postphenomenology conceptualises the relationship between human beings, technology, and the world in terms of a continuum and technological mediation (Ihde 1990; Verbeek 2005) and represents this relation through the formula:

human – technology → world

In postphenomenological formulas, the arrow indicates intentionality (Verbeek 2008).

Ihde recognises four primary relationships humans can have with technological artefacts: *embodiment relations*, *hermeneutics relations*, *alterity relations*, and *background relations* (Ihde 1990, 72-111; 2009, 42-44).

In *embodiment relations*, humans engage the world with the use of technologies or artefacts. Technology can be embodied by its users, determining a relationship between humans and the world. Glasses allow humans to see through themselves, or the telescope allowed Galileo to see the craters on the moon (Ihde 1990, 73); in both cases, an artefact or an instrument is *incorporated*, and it becomes an extension of the human body. Ihde (1990, 89) represents this relation through the formula:

(human – technology) → world

In *hermeneutic relations*, technologies deliver representations of reality, which need interpretation. A thermometer, for example, displays a value that requires to be read and interpreted for knowing the temperature. Ihde (1990, 89) represents this relation through the formula:

human → (technology – world)

In *alterity relations* (Ihde 1990, 97), technologies are the end of our experience. Humans interact with a device, such as using a printer to print an archaeological report. A permutation of the postphenomenology formula describes this relation:

human → technology (– world)

In *background relations* (Ihde 1990, 108), technologies are simply part of our environment, and they are taken for granted and create a context for

our perceptions (Verbeek 2008), like the automated backup of data. The following permutation describes background relations:

human (– technology – world)

Apart from alterity relations, human intentionality is constantly mediated by technologies. Human beings do not experience the world directly but rather through a mediating artefact that forms a definite relation between them and the world. This paper will focus on the first two relations described.

3. Digital Archaeology from a Postphenomenology point of view

Postphenomenology considers that hermeneutics is tightly bound to materiality in natural and human sciences (Ihde 2009, 68). It calls this *material hermeneutics*. Archaeology, which is based upon material evidence (Chapman, Wylie 2015), has material hermeneutics per se. Let us take the example of the study of the body of Otzi the Iceman. The scientific instruments for analysing the Otzi body turn it from its condition of a mute thing into a speaking object and allow archaeologists to give voices to things (Ihde 2009, 70). However, the use of technology entails embodiment; it changes the human body to become a larger entity that includes technological artefacts (Rosenberger, Verbeek 2015)[1] and becomes part of our experience of the world. As long as it enters our body, technology withdraws, becomes quasitransparent, and thus it is not object-like; instead, it is a means of experience, not an object of experience in use (Ihde 2009, 42).

In embodiment relations, the partial symbiosis of the human with the technology is given by the latter's capacity to become perceptually transparent (Ihde 1990, 86). Embodiment relations include the paradox between total transparency and omnipotence (Ihde 1990, 75). Total transparency means total embodiment, whereas omnipotence means having the power the technologies make available. This paradox can also be found in the digital sphere, between the transparency of the infrastructure that allows the use and transformation of information and the hardware that needs to be continuously updated as it is never considered adequate (Wellner 2020)[2]. For Wellner, the difference in digital technologies is that they are indirectly effective on the body.

[1] This concept came from Merleau-Ponty's phenomenology. In his analysis of the blind man's cane (Merleau-Ponty 1962, 144), the body intentionality extends through the artefact into the world in a distinctive technological mediation. This kind of embodiment results familiar to archaeologists. The trowel for an archaeologist is no longer perceived as an object. Its point and blades have become an area of sensitivity. The archaeologists feel the composition and compactness of the sediment and its changing through the trowel, which they feel like an extension of their arm and hand.

[2] Continuing the trowel example, the paradox is between the total transparency of the trowel, i.e. digging without perceiving it as an instrument, and the omnipotence given by the power of the trowel in digging everything.

Nevertheless, it could be argued that digital technologies are often embedded in a thing, as the ArchAIDE app is embedded in a smartphone. In this way, the smartphone has an embodied relationship with the body, and AI amplifies that. We will come back later to this point.

Along the human-technology continuum envisaged by Postphenomenology, hermeneutic relations follow but do not depend on embodiment relations (Ihde 1990, 80). Postphenomenology defines hermeneutic relations as those through which we extract information and interpret the world through technologies. Digital technologies also engage meaning-oriented capacities, which implicate reading, i.e. extraction and interpretation (Wellner 2020). Hermeneutic relations are formalised by a permutation in which the technology and the world elements form an entity with which the human interact:

human → (technology–world)
Archaeologist → (hyperspectral camera – flint)

The already mentioned study of Otzi the Iceman body shows the need for archaeology «to utilise […] material investigation» (Ihde 2009, 69) and achieve material hermeneutics. Indeed, material hermeneutics «gives things voices where there had been silence and brings to sight that which was invisible» (Ihde 2005) and «reveals the written accounts to be partial and in some ways to show phenomena that are in tension with the written accounts» (Ihde 1990, 73). There is a co-constitution of humans and their technologies ontologically interrelated. This implies that «transformations are non-neutral» (Ihde 2009, 44). In other words, «both what is experienced and how one experiences the object are changed. Technologies transform our experience of the objects in the world non-neutrally» (Ihde 1990, 47).

In Digital Archaeology, hermeneutic relations can be easily shown using technologies related to the representation of a particular view. Even a photograph has a specific point of view, assumptions, and potential biases. For example, a monument represented by a digital camera can supply a different interpretative perspective from the image of the same monument portrayed by a hyperspectral camera. These different perspectives highlight the non-neutrality of technology. Furthermore, these aspects are essential and intrinsic in hermeneutic relations. They become even more evident when archaeologists use algorithms to identify bare-earth or ground within a point cloud to create a Digital Surface Model from airborne LiDAR data. For example, the so-called vegetation removal algorithms allow us to reveal features hidden by woodland canopies and can direct to unforeseen inferences (Devereux *et al.* 2005). Nevertheless, different filters for ground extraction from airborne LiDAR point clouds are not qualitative and quantitative analogous, and each filter has biases compared to the others (Štular, Lozić 2020).

Shifting the point of view a bit makes it possible to give technology intentionality. Scholars like Verbeek (2008) suggest that technologies can have intentionality that directs to specific ways of operating or thinking and, more widely, to a specific interpretation, distinguishing it into *hybrid intentionality* and *composite intentionality*. Hybrid intentionality refers to human/technology merging rather than interacting, whereas the latter refers to the composition of intentionalities of human and technological artefacts. The former is associated with half organic, half technological beings, such as *bionic* beings or cyborgs. We will not consider this interaction because it is not developed in archaeology. The meaning given by Verbeeck is different from the concept of Cyborg Archaeology by Morgan (2019). In composite intentionality, intentionality is directed to construct reality and show a novel way of seeing the world instead of representing a phenomenon (Verbeek 2008). For example, hyperspectral imaging produces a visible image of an archaeological artefact showing molecular bonds that are not visible to the human eye. In this case, the instrument translates the molecular bonds into bodily perceivable images.

This *translation* is a technological transformation of a phenomenon into a readable image. Because it brings into presence previously unknown phenomena, it does so through a hermeneutic process, i.e. a process that is not limited to textual or linguistic phenomena, by translating what is detected into images that embodied observer can read. Here, hyperspectral images and other imaging techniques used in archaeology allow experiencing phenomena that otherwise would not be perceptible by the body but become experienced because they are technologically mediated. From a Digital Archaeology perspective, it is essential to underline that sensors perceive data that the human eyes cannot detect. Then, in a double translation process, data is processed through the digital conversion into image and image into data that allow the image construction (Ihde 1990, 92). In this case, technological intentionality is not directed at representing a phenomenon; instead, it constructs reality. The addition of human and technological intentionalities is addressed «at making accessible ways in which technologies 'experience' the world» (Verbeek 2008).

Furthermore, we can use different technologies to analyse a potsherd or a prehistoric flint. Hyperspectral imaging, X-ray fluorescence (XRF), and Raman spectroscopy could be applied. Each produces a slice of the overall information and shows different aspects of the artefact. This is a phenomenological variation. Smart glasses offer an even more evident example, as in the restoration of Alexander the Great's mosaic in the Archaeological Museum of Naples (MAN) (Museo Archeologico di Napoli 2021). Smart glasses and Virtual Reality (VR) allow a bodily extension of the observer's perception, capable of experiencing what the human eye cannot perceive. Here, smart glasses perform hermeneutics and digitally mediate the experience of the world.

In Digital Archaeology, visualisation is dominant. If, in the beginning, such a visualism has been decried as reductive in respect of linguistic hermeneutics, now digital applications such as Augmented Reality (AR) or GIS and other imaging practices have produced a very sophisticated *visual hermeneutics* (Ihde 2009, 64). In the case of ARtefactKit (The ARtefactKit 2017), a multi-sensory AR application allows archaeologists to compare an excavated animal bone with bones from a 3D virtual reference collection to aid identification and examination. The application makes it possible to see and hear the real animals from which the bones are derived, distribution maps, and other data. In the case of GIS spatial analysis (Gillings *et al.* 2020), where again composite intentionality operates, maps are obtained from algorithms that analyse the data and display a visual model like the case of viewshed or least-cost analysis. In both cases, visual hermeneutics is performed, i.e. a more perceptual than linguistic interpretation is applied when we investigate nonspeaking, nonwriting, and nonlinguistic phenomena.

The massive use of 3D models in Digital Archaeology represents *constructive intentionality*, a different type of composite intentionality (Verbeek 2008). 3D models, especially in interactive and immersive virtual reality, produce highly realistic representations of a reality that could not have occurred in the past. These models do not depict the past's reality as it existed; instead, they create a new reality of the past that occurs because human intentionality is accompanied by technological intentionality. The 3D and photorealistic models have not equivalent to the past reality. The intentionality given by researchers to the 3D immersive virtual reality is not directed at making an existing reality of the past visible but at constructing a new reality of the past. This aspect appears clearly in 3D visualisation for reflexive archaeology developed at Çatalhöyük (Lercari 2017), where highly evocative reconstructions of one of Çatalhöyük history house was built to foster multiple and inclusive interpretations (Perry 2015).

To sum up, in composite intentionality, two forms of intentionality are involved: technological intentionality directed toward *its* world and human intentionality toward the preceding technological intentionality's outcomes. Here, humans are addressed/targeted at how technology is directed in the world (Verbeek 2008). Composite intentionality is described by adding an arrow between technology and the world:

human → (technology → world)
Archaeologist → (3D software → Archaeological reconstruction)

If, in general, this variation represents the way in which digital technologies create a trace in the world (Wellner 2018), in archaeology, this variation describes how digital technologies produce a trace in how we represent the materiality of the past.

Furthermore, in composite intentionality, the outcome and the instrument, e.g. the hyperspectral image and the hyperspectral instrument, compose the *technology* element. This element can be split between materiality, which is intertwined into hermeneutic relations, and the information handled by materiality for dealing with digital materials. Wiltse (2014) proposes to separate technology into *substrate* (materiality) and *trace* (information) because distinctive technologies take part in producing information and its display. The same separation exists between hardware and software, where the invisibility of materiality and the visibility of immaterial information produce a paradox (Wellner 2020). The creation of information is normally concealed while the information is shown, gaining users' attention. The virtual becomes visible, and the physical invisible; accordingly to a Heideggerian perspective, it withdraws. This detaching between writing and displaying is exemplary of the digital environment. A vertical separator represents it in the permutation of the postphenomenological formula where the substrate faces the world while the trace faces the human (Wiltse 2014):

human → ([trace | substrate] → world)
Archaeologist → ([Hyperspectral imaging software | Hyperspectral camera] → archaeological remains)

This permutation describes the hermeneutic relations in digital environments and underlines the importance of materiality in this process. The hardware we use to mediate ourselves as archaeologists with the materiality of the past is not a secondary aspect of archaeological interpretation. It does not depend on computing power alone; instead, it is intrinsic in the digital sphere's hermeneutics.

More complexity can be envisaged. Every instrument has embedded digital software and hardware within it, which determine its capabilities (and limitations). Consequently, different versions of the same instrument, as well as altering the settings on the instrument, will produce different outcomes. Differently from Wiltse (2014) and Wellner (2020), it is possible to suggest a different permutation mapping the trace ('information') to data rather than software. The definition of the paradox seems to underline the problem: if the visualised information ('trace') is facing the human, and the device ('substrate') is facing the (archaeological) world, the creation of information presumably sits in the software. So, the earlier mapping of trace onto software should instead be onto the software's output, which means the software does indeed sit somewhere between trace and substrate.

human → ([data – |trace – | substrate] → world)
Archaeologist → (Data visualisation – | Hyperspectral imaging software – | Hyperspectral camera] → archaeological remains)

Tools for multi-sensorial engagement, such as VR goggles, AR tools, vibrating-haptic simulating gloves, and virtual treadmills to virtualise and augment reality and explore artefacts, museums, archaeological sites, or landscapes are widely used in digital archaeology (Eve 2017), and critiques on their application have already been produced (Eve 2012). Nevertheless, postphenomenology can be applied to understand the virtual tool-user relations by examining how the physical and virtual aspects are blended, as in the case of AR tools. In this case, it is possible to distinguish between *technology* (the technological artefact) and *object* (the information) and propose a permutation that does not consider the world component, revealing, instead, which of the two elements attracts the users' attention (Liberati 2016).

human → ({Object}– Technology),
human → (Object – {Technology}).
User → ({AR archaeological reconstruction} – Mobile device),
User → (AR archaeological reconstruction – {Mobile device}).

The curly brackets indicate which element entices the user's attention: the hardware or the information. The absence of the world element is related to the nature of virtuality that blurs the boundaries between the world and the information (Wellner 2018). In this way, the materiality of the past is experienced and interpreted together with the information, i.e. the display, and the users' attention could be enticed more by the display than the artefacts, i.e. the past.

In archaeology, AR tools are related to material remains or the landscape where material remains laid, so standing attention to which element entices the user's attention, the world element could be added, taking care of the former point:

User → ({AR archaeological reconstruction} – Mobile device → archaeological remains),
User → (AR archaeological reconstruction – {Mobile device} → archaeological remains).

AR example clarifies how humans can be considered 'artefacts' shaped and used by machines, with humans reacting to technological stimuli rather than vice-versa (Demetis, Lee 2018, 930).

4. Postphenomenology and AI

AI is gradually becoming part of everyday archaeological practice. Consequently, it is paramount to address the challenges posed by autonomous digital tools possessing technological agency before they are more widely employed within archaeology (Huggett 2021). Attention must be paid to epistemology, hermeneutics, technological agency, and competitive cognitive

artefacts, which raise concerns about digital practices and autonomy lying beyond human control.

In the digital world, technologies not only give voice to things but also support information to talk. Let us develop this concept. The first link in the chain is big data. Any AI application requires large amounts of data to train a neural network which contains thousands of layers and parameters. The ResNet-50 network used for ArchAIDE appearance-based recognition is composed of a sequence of blocks whose maps are multidimensional and include many channels, whereas the network for shape-based recognition, based on PointNet, is even more complex (Anichini *et al.* 2021). By finding correlations between data, the focus moves on technologies' role in producing an interpretation, i.e., on the mediating role of algorithms in perceiving the world. From this point of view, a new AI application, as possibly in the case of ArchAIDE, may determine new informational structures and even lead to changes in the content itself.

As Gattiglia (2015) discussed, Big Data is also connected with the process of datafication. Differently from digitisation, which is the migration of something in digital support, therefore is an heir of the analogue age as in the case of a digitised document such as an archaeological report or an excavation plan, datafication is the transformation of an object or a phenomenon in tabular data that can be analysed through algorithms. This is the distinction envisaged by Manovich (2013) between a *document* (digitisation) and a *performance* (datafication). The former represents a fixed visual representation that can be accessed identically and repeatedly. The second represents multistability, i.e. «the idea that technologies can be put to multiple purposes and can be perceived to have different meanings for different users» (Friedirch *et al.* 2022). In the performance, AI algorithms deliver information and define how it is presented to the users. More precisely, the performance differs based on when, how, and who uses the app.

In ArchAIDE appearance-based recognition, the same potsherd of Majolica of Montelupo photographed with different devices or viewpoints, et cetera, and sent to the classifier always maintains the 83% probability of being in the list of the top five outcomes. However, the degree of confidence the algorithm gives can vary; the correct result could be listed in a different position and perceived differently by users. By being a performance, the information cannot be exactly reread because it changes every time it is displayed. Nonetheless, the performance can perform hermeneutics by extracting meaning from data through a virtual cognitive process embodied in computational media (Hayles 2017). In the case of ArchAIDE, the neural network extract meaning from the data used during the training and perform cognition through its embodiment in the smartphone or tablet. This process represents an act of knowing and can be considered cognition, which, unlike thinking, can be achieved by humans and non-humans, including technology. These cognitive capabilities give the

algorithms «a strong evolutionary potential than any other technology […] which [...] enable them to simulate any other system» (Hayles 2017, 33).

This digital material hermeneutics is associated with technological materiality. The materiality of the device constrains potential uses because technology cannot be whatever the user wants it to be. In the case of ArchAIDE, the digital material hermeneutics is coupled with the mobile device's materiality. In other words, AI technology actively mediates the world and possesses technological intentionality, i.e., it directs to a specific interpretation. Therefore, hermeneutic relations in AI reflect the algorithms' technological intentionality. In ArchAIDE, the neural network is coupled with the smartphone and directs to a specific interpretation, i.e. the recognition of a potsherd as belonging to a particular type. The algorithm achieves the interpretation and directs the user on what to read. Consequently, AI algorithms have autonomy and intentionality; they require cognition and create a trace in the world. This non-anthropocentric shift embodies the more and more crucial role of AI algorithms. In the AI age, Archaeology's challenge is to recognise technology as an agent (Huggett 2021) on whom we depend on extracting meaning and, at the same time, as something that partially reflects our hermeneutics (Wellner 2020).

More in detail, we can split the technology element into two, distinguishing between the algorithm and the data. To describe this new perspective, Wellner (2020) suggests a new permutation reversing the arrow to reveal the algorithms' technological intentionality and separate the technology element into *tech* (i.e., the algorithm) and *information*:

human → tech → information → world
Archaeologist → ArchAIDE Neural Network → automated recognition → pottery

In Wellner permutation, the tech element faces the human element and is followed by the information because the algorithm (tech) performs hermeneutics and directs the humans what to read. In contrast, the arrow between the information and the world represents the trace left in the world.

Finally, let us consider how a neural network is developed; this process is partly due to human choice and partly to technology intentionality. In the case of ArchAIDE, the neural network has been created by humans based on human-made catalogues, which define ceramic types based on morphological or stylistic characters determined by archaeologists and by the digital technology intentionality of the algorithm itself. In this case, we are in front of *composite intentionality*: the AI intentionality related to the algorithm and the human intentionality inherent to the creation of the algorithm and the establishment of the ceramic types. This process contains biases but also agency, understood in terms of the technology's mediating ability (Verbeek 2005).

In ArchAIDE and more in AI, we can imply a composite agency, a human agency given by human intentionality in building the neural network, and a

technological agency given by digital technology intentionality. This represents an even more disruptive element because when we use AI, the algorithm performs hermeneutics, but it is hybrid intentionality, in which humans and technology merge through their agency, creating a symbiotic agency (Demetis, Lee 2018, 944). Programmers design deep learning algorithms by which these systems generate classification, but even for them, it is often difficult to understand how algorithms come to conclusions. Algorithms also depend on large amounts of data to build a robust model, which raises concerns about data quality and provenance. Moreover, the training data set constrains the construction of the algorithm itself and may also encode human misunderstanding and bias (O'Neil 2016). When ArchAIDE gives its five answers, who is answering is a hybrid agent. The application allows archaeologists to choose if the algorithm suggests the right answer. Are we sure ArchAIDE app allows archaeologists to perform hermeneutics?

From an epistemological point of view, this reasoning leads us to the black-box question. AI appears ontologically distinct from other technologies. While a digital camera enables the proper exercise of archaeology, AI threatens it because AI has peculiar traits that make it seem unlike other technologies habitually used in archaeology. Archaeologists do not directly control AI the way they control a total station; neural networks, once programmed, are internally autonomous. Further, even if the triggering controls of AI may look similar, the outputs are different. This is what we have called a *performance*. AI is mining data in ways not wholly delineated or anticipated by its designers. In other words, a black box generates outcomes, but knowledge of how they arrive remains hidden. It is seen as a mysterious, inscrutable, powerful entity connected to a «data-driven algorithmic culture» (Striphas 2015, 396). If archaeologists cannot trust and verify that the AI algorithm has made a correct identification, the result cannot be used in research.

ArchAIDE has worked in this direction, trying to transform the black box into a glass box capable of revealing what was hidden. Indeed, ArchAIDE made use of open source software and made the code accessible on the MAPPA Lab GitHub repository (https://github.com/mappaLab/archaide-software). However, understanding the code requires technical skills and algorithms «based on training data do not naturally accord with human semantic explanations» (Burrell 2016). Other methods for accessing digital black boxes have been suggested, among others, by Barredo Arrieta *et al.* (2020), Bucher (2016), Christin (2020), and Huggett (2017). All these solutions are challenging and far from straightforward. Not only because of the complexity and opacity of neural networks composed of complex layers of connected nodes but because of the two-sidedness of technological mediation, i.e. the epistemological *revealing* and *concealing* transformation of the world produced by technological mediation (Ihde 1990, 49). When analysed through postphenomenological

lenses, explainability, or its lack, appears like a feature of technological mediation and does not make black-box AI so risky for archaeology as to must be put aside. The lack of explainability is merely an aspect of the ontological revealing-concealing dimension, not a novel concern in its own right, and archaeologists may be more cognizant of their own by paying attention to this dimension of technological mediation. Nevertheless, AI algorithms may alienate archaeologists from their object of research and create further divisions between those who have the knowledge for implementing AI models and those who do not, creating disequality in the research. If the technology cannot be explained, archaeologists may also feel alienated from their role as knowledge-bearers. Here is not the mediating effect itself that is negative, but rather how archaeologists fail to attend to the mediating effects of technology that can produce poor research outcomes based on unintentional use of the technology.

When explainability threatens to alienate archaeologists from their ability of interpretation, there is an opportunity for them to become sceptical towards the use of AI. These are not concerns, per se, but rather effects of technological mediation that call our attention to some aspects of archaeological practice.

5. Conclusion

The archaeological record has been seen as intrinsically and radically digital in its nature, genesis, and epistemological structure because archaeology operates from the bottom up, building its interpretation starting from fragments rather than from the whole and breaking it down (Buccellati 2017, 232-233). In other words, archaeology is intrinsically digital because it performs material hermeneutics, but turning the inside out, it performs material hermeneutics because it is digital. This means that archaeology is affected by the mediation's role of digital technologies. We collect data with digital instruments (e.g. using a GPS for geolocalisation or TLS for archaeological surveys), we manage data using software (and specific hardware) such as RDBMS or GIS, we analyse data with statistics packages such as R, or with GIS and through their mediation we perform hermeneutics and visual hermeneutics. Because we «live and move and have our being in the midst of our technologies», they mediate the world for us, often in uncritical ways (Ihde 1990, 1).

Digital technologies used in archaeology allow experiencing phenomena that otherwise would not be perceptible by the body but become experienced because they are technologically mediated. Furthermore, digital technologies have an intentionality that is not directed at representing a phenomenon; instead, it constructs reality. To sum up, archaeology is mediated by never neutral instruments, and our knowledge of material evidence depends on the technology used. In other words, archaeologists, together with digital technologies, create a reality of the possible pasts.

All these aspects may seem intuitive. They become counterintuitive when we use AI algorithms. Here a sense of disruptiveness appears. When technologies support information to talk, everything changes. We cannot understand how the algorithms work, and we feel as being in front of a black box, but rather because algorithms perform hermeneutics instead of humans. When the ArchAIDE algorithm recognises pottery, or when a Convolutional Neural Network recognises archaeological features from a digital ground model derived from an airborne LiDAR, algorithms perform cognitive processing. Their autonomous digital technological intentionality creates information, performs hermeneutics instead of us and finally directs archaeologists on what to read. For example, ArchAIDE offers five answers and leaves archaeologists a final control, but are we sure archaeologists can really understand how those answers were derived? Here, the critical question becomes whether the algorithmic mediation, digital hermeneutics and cognitive outputs are capable of explanation. At present, they are not or if they are, the explanations are either uninterpretable or greatly simplified. Even if transparency seems achieved by publishing the source code on GitHub, the high specialist skill level needed for their understanding produces a form of opacity given by technical illiteracy (Hugget 2021). On the other hand, using human semantic explanations is equally problematic because it does not naturally accord with neural networks (Burrell 2016, 10). All this delivers ethical questions related to the difficulties (or rather impossibilities) of verifying what cannot be fully understood.

Finally, when we infer knowledge based on algorithms, we should be aware that the intentionality of the algorithms mediates our reconstruction of the past. Again, it is a model, one of the possible pasts. In the AI age, the understanding of the past is non-anthropocentric. Digital technology is an agent on whom we depend on extracting meaning and, at the same time, partially reflects our hermeneutics because in training a neural network, we use our knowledge, and in some way, we transfer our agency to algorithms. The next challenges for AI in archaeology will include understanding how inscribing agency into the algorithms may lead to algorithmic bias (O'Neil 2016), which reflects human bias. Ihde (1990) describes the phenomena of human-technology relations, considering the multiple ways humans can interact with the world through technologies and, more interestingly, how, through these relations, humans and technologies «become what they are» (Gertz 2018, 45). The ontological, practical and ethical dimensions of technological mediation of *revealing-concealing*, *enabling-constraining*, and *involving-alienating* also shape human experience (Kiran 2015). What composes the world for us is revealed through engagement with technologies, and whatever does not belong to this context is concealed. In digital technology, concealing leads to *double forgetfulness*. We forget to ask questions, and that «things, the world, could be revealed in different manners» (Kiran 2015, 128).

In the practical enabling-constraining dimension, technologies enable us to do certain things. When we use a specific technology, from XRF to AI: it enables us to do things we otherwise could not do. Nonetheless, as in Hodder's Entanglement theory, this positive enabling also has a related constraining: technology shapes how we do things but diverts our attention from other possible ways of doing it. Finally, in the ethical involving-alienating dimension, «technologies constitute situations as ethical situations, with specific limitations on how the ethical issues are formulated (or formulate-able), and they constitute actors as ethical actors, with specific restraints on how we can behave and choose» (Kiran 2015, 135). For example, the physical distance that occurs in online 3D models is alienating by excluding physical contact with the archaeological artefact. In contrast, algorithms for AI image recognition create the possibility for further alienation. However, this technology is not per se negative; rather, by being not neutral, it leaves it to us to determine how and to what extent we will receive and engage with digital technology, especially AI.

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ABSTRACT

Digital technologies are not neutral tools; rather, they mediate our knowledge of material evidence. This contribution stems from the reflections on the sidelines of the ArchAIDE project, which developed AI tools to recognise ceramics and attempts to answer questions, among others, on how technological intervention takes place in archaeology, particularly through AI, and if such effects are disruptive concerning epistemology and hermeneutics. Postphenomenology and material hermeneutics have been considered to describe the relationship between archaeology and digital technology. In the AI age, Archaeology's challenge is to recognise technology as an actor (or maybe as an agent) on whom we depend on extracting meaning and, at the same time, as something that partially reflects our hermeneutic. The algorithms have digital technological intentionality that creates information, performs hermeneutics in our place, and finally directs archaeologists what to read. This act of knowledge is performed instead of ours. If, in Heidegger's ontological inversion, science becomes dependent on technology and, in a sense, a tool of technology, in the same way, archaeology has become dependent on technology and entrapped by it.

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